

CLAIMS

1. An electromagnetic rotary actuator to be controlled by a single voltage and comprising a rotor movable about an axis and having permanent magnets and a stator carrying at least one winding and an airgap between facing surfaces of the permanent magnets and of the stator, the permanent magnets being arranged to have flux lines extending in the airgap substantially in a radial direction from or towards the axis, characterized in that the stator have at least three pole teeth made of a magnetically permeable material, in particular a soft-iron material, the at least one winding being applied around a central one of the pole teeth and the pole teeth having end surfaces forming the facing surface of the stator and thus facing surfaces of the permanent magnets over the airgap.

2. An electromagnetic rotary actuator according to claim 1, characterized in that the end surfaces of the pole teeth are located close to the facing surfaces of the permanent magnets creating a small airgap, the airgap being preferably smaller than 0.5 mm and most preferably smaller than 0.3 mm.

3. An electromagnetic rotary actuator according to any of claims 1 - 2, characterized in that at least three pole teeth carry windings, all windings being connected to one single voltage source, and the pole teeth carrying windings being located centrally, preferably around a central pole tooth.

4. An electromagnetic rotary actuator according to claim 3, characterized in that actuator comprises five pole teeth, the two pole teeth which are not located centrally being unwound.

5. An electromagnetic rotary actuator according to any of claims 1 - 4, characterized in that the actuator comprises exactly three pole teeth and the pole teeth are arranged within an angle, taken from the axis, of at most somewhat more than a third of a full turn, in particular within an angle smaller than 130° .

6. An electromagnetic rotary actuator according to any of claims 1 - 5, characterized in that the actuator comprises exactly five pole teeth and the pole teeth are arranged within an angle, taken from the axis, of at most somewhat more than half a full turn, in particular within an angle smaller than 225° .

7. An electromagnetic rotary actuator according to any of claims 1 - 6, characterized in that the rotor and stator poles have the same angular pitch.

8. An electromagnetic rotary actuator according to any of claims 1 - 7, characterized in that an angular sector extending between the two outermost ends of the pole teeth portions facing the air gap is longer than the sum of the peak to peak movement of the rotor and an the angular sector extending between the two outermost ends of the rotor magnet or magnets facing the air gap.

9. An electromagnetic rotary actuator according to any of claims 1 - 8, characterized in that an the angular sector between the two outermost ends of the pole teeth portions facing the air gap is substantially equal to the sum of the peak to peak movement of the

rotor and an the angular sector extending between the two outermost ends of the rotor magnet or magnets facing the air gap.

10. An electromagnetic rotary actuator according to any of claims 1 - 9, characterized in that an angular sector extending between the two ends of a stator pole tooth facing the air gap is longer than the sum of the peak to peak movement of the rotor and an angular sector extending between an end of a rotor magnet part facing the air gap and the nearest end of an adjacent rotor magnet facing the air gap.

11. An electromagnetic rotary actuator according to any of claims 1 - 10, characterized in that the normally cylindrical surface angular sector of at least one stator pole part facing the air gap to the rotor magnet pole parts have an adjusted shape to reduce the cogging torque of the actuator.

12. An electromagnetic rotary actuator according to claim 12, characterized in that the two outmost stator pole air gap surfaces have an adjusted shape to reduce the cogging torque of the actuator.

13. An electromagnetic rotary actuator according to any of claims 1 - 12, characterized in that each of the stator poles carrying winding coils has a reduced height in the axial direction at places of the stator pole where the winding is located, thereby permitting a portion of the stator pole located at the airgap and at a radially inner surface of the stator pole to be longer in the axial direction than a portion of stator pole located inside the stator pole winding.

14. An electromagnetic rotary actuator according to any of claims 1 - 13, characterized by an electronic driver circuit connected to the at least one winding and comprising resistance changing means to increase a resistance in series with the actuator winding when a longer electric time constant is advantageous or required and to reduce the resistance in series with the actuator winding when a short electric time constant is advantageous or required.

15. An electromagnetic rotary machine having a rotor rotatable about a rotational axis and a stator comprising magnetically permeable stator poles carrying winding coils, each of the winding coils being assembled around a single one of the stator teeth, a cylindrical or part-cylindrical airgap being located between a radially outer surface of the rotor and radially inner surfaces of the stator poles, characterized in that each of the stator poles carrying winding coils has a reduced height in the axial direction at places of the stator pole where the winding is located, thereby permitting a portion of the stator pole located at the airgap and at the radially inner surface of the stator pole to be longer in the axial direction than a portion of stator pole located inside the stator pole winding.

16. An electronic circuit for driving a single phase rotary actuator, particularly an actuator having a long electric time constant, the electronic circuit being connected to a winding or windings of the actuator, characterized by resistance changing means to increase a resistance in series with the actuator winding when a longer electric time constant

is advantageous or required and to reduce the resistance in series with the actuator winding when a short electric time constant is advantageous or required.

17. An electronic circuit according to claim 16, characterized in that the resistance changing means comprise a first bridge leg directly connected to a terminal of the actuator winding and a second bridge leg connected through a resistor to the same terminal of the actuator coil.

18. An electronic circuit according to claim 17, characterized in that the resistance changing means comprise means for varying the impedance of a resistor having a controllable resistance, in particular a MOSFET.

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